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Result Page

The instant invention concerns a method for steering a chemical valve in accordance with the preamble of the claim 1.

As chemical valves referred one porous membranes, whose porosity characteristics through in the most general sense of chemical or also thermal-physical processes controlled to become to be able. The permeation of solutes by such stimulus responsive membranes leaves itself by external attractions, like z. B. Temperature, pH value or concentration regulate. The material transfer becomes by the predetermined concentration and/or. Pressure drop certain. Thus conditional, can be supervised the material transfer not to electric, to be regulated only slow ones with time constants in the minute and hour range, to be switched not complete and in and off, as well as off at short notice complete. A chemical valve with porous matrix and a swellable a gel layer by their site conditions, with which the matrix is a micropore diaphragm, whose pores are by corroding particle-pure in that matrix generated, is from the DE HP of 43 05 979 C2 known.

Of it outgoing is it object of the instant invention to indicate a method with which with a chemical valve with a membrane of the indicated type of above disadvantages avoided and the desired positive properties achieved to become to be able. The method should make possible an incorporated sensor function with direct electric supervision barness of the material transfer, for extreme rapid within the millisecond range more controllable and thus and. A. for the delivery of medicines suitable its. The maximum permeability chemical should be more predeterminable and the material transfer at short notice in and disconnectible.

To the solution of the object the instant invention suggests a method with the features, which are in the characterizing part of the claim 1 mentioned. Other ones, advantageous embodiments of the method are to be seen in the characterizing features of the Unteransprüche.

By the combination according to invention of a responsiven membrane with an external switchable power source a chemical valve with a membrane system ensteht, an incorporated sensor function with direct electric supervision barness of the material transfer included. This possible extreme rapid regulation procedures, z. B. the delivery of medicines, with time constants in the second to millisecond range, whereby the maximum permeability of the chemical valve is more predeterminable chemical and its material transfer can in and be switched off to complete and at short notice.

Details of the method become in the following and more near explained on the basis the fig, which shows the principle of a new chemical valve with an ion trace diaphragm, based on the method:

In a cell 1 is thermal or chemical reponsive nano-porous membrane, like z. B. with one glucose responsiven gel lined micropore diaphragm 2 used, which exhibits a single pore 3 located in the responsiven gel in simplified representation, whereby also arbitrary many pores are in the membrane possible. The pores exhibit characteristic diameters within the range of 10 to approximately 1000 Nm. The cell 1 kept at a moderate temperature by a circuit 8 is filled with an aqueous solution 4 as electrolyte, whereby the effective diameters of the pores 3 by the glucose concentration within the two electrolyte ranges 5 and 6 of the solution 4 as basic value adjusted becomes. Into the two electrolyte ranges 5 and 6 on both sides of the membrane 2 is one preferably not polarizable electrode each 7 from z. B. Ag/AgCl immersed, to which by means of the power source 9 an electric change or direct voltage applied becomes. The electrolyte range 5 participates as the interior of a system, in which a fabric who can be delivered is and who electrolyte range 6 as the outside space referred, discharged into which the fabric transported by the pores 3 becomes possibly a reaction. The change or direct voltage set on the electrodes 7 leads now to an electric current by the Pore/n 3, that depending upon its direction an electrical osmotic pressure of the outside space 6 to the interior 5 or reverse and additional or alone for itself a simultaneous temperature change in/the pores 3 effected.

The electricalthermal control happens thereby as follows:
The thermal responsive membrane 2 becomes in by external thermostats cell before-kept at a moderate temperature 1, z. B. a conductance measuring cell, incorporated. The cell 1 possesses, as already mentioned, the two electrolyte ranges 5 and 6 which are 2 from each other separate by the membrane. In the half, the interior 5 to the other half, the outside space 6 fabric who can be delivered, z Is. B. Insulin in aqueous solution a bottom hydrostatic pressure between 0 and 10

bar. As soon as now 1 sent over the electrodes 7 an electric equal or alternating current becomes by the cell, heated the liquid in the pores 3 that thermal responsiven themselves membrane 2. Thus these rapid on a temperature above the critical temperature z become. B. hydrogel an heated, whereby the membrane 2 and/or. the pores 3 shrink and the fabric of the inter or 5 into the outside space, who can be delivered, 6 pressed become. As soon as the electric current becomes interrupted. the membrane cools 2 and/or. the pores 3 again off, the hydrogel pours and the volumetric flow by the pores 3 becomes interrupted. The material delivery can be steered thereby in the second to minute range.

The electricalosmotic control of the membrane 2 becomes partly with geöffneter/n pores 3 by corresponding polarity of the voltage of the external power source 9 by means of the electrodes 7 over the pores 3 and/or. of an electrolyte range 5 and 6 on the other hand by the voltage difference an electricalosmotic pressure generated, which is the hydrostatic pressure of different liquid levels of the two electrolyte ranges 5 and 6 either against or rectified. With this method is a responsive complete suppression rapid opposite the electricalthermal control and/or. increased material delivery by the pores 3 possible. The material delivery can be steered here in the millisecond to second range.

With the process steps mentioned the micropore diaphragm can become additional in or reciprocal a chemical attraction exposed, whereby a chemical attraction can exist with a membrane lined with glucose responsivem gel of the concentration gradient of glucose molecules in an aqueous solution as electrolyte.

As embodiment, circuit of the membrane 2 by heating of the hydrogel in a variety of pores 3 of the membrane and/or. by electricalosmotic generated pressing, In the following the preparation of a thermal becomes - responsiven, electric switchable. nano-porous membrane 2 described:

1. Preparation of an ion trace filter membrane

19 mu m thick Polyethyleneterephtalate film becomes with (5,4+/0,5) x10< 5> Gold ions of 11.6 MeV/nucleon (MeV/u) per cm< 2> irradiated and in 5 N NaOH solution with 40 DEG C during 260 min etched. This leads M. to approximate cylindrical pores with diameters of 2.9+/0,2 mu m and lengths of 17,7 mu.

2. Plug that thermal responsiven gel layer

The chemical Propfen the etched ion trace diaphragm in 10 a weight-per cent expenditure-gassed aqueous solution N-isopropylacrylamide of monomer of impregnated and with 60 DEG C in the vacuum with gamma rays becomes <60> CO source with a dose rate of kGy per hour irradiated. From this a thermal responsive membrane with the required properties results.

The invention process included now whole series of advantages:

- an electric sensor function, D. h. the material transfer is electric supervisable
- the method is integrable into a medicine delivery system
- is small the machine effort for the method
- it is electricalosmotic pumps and/from switching possible
- the membrane requires only fewer production steps and is monolitisch producible
- by high pore-dense an high throughput is possible, whereby pores of most different, also asymmetric geometry can come to the use.

Reference symbol list
1 cell
2 nano-porous membrane
3 responsive pore
4 electrolyte
5 electrolyte range interior
6 electrolyte range outside space
7 electrodes
8 keeping at a moderate temperature
9 power source